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ABSTRACT

From March, 1987, through June, 1988, an inservice program took place to help teachers in grades 3 through 6 improve their skills in teaching mathematics and science. The teachers, from central and southern Indiana, met for a week in June, 1987, and for 3 days in June, 1988. From October, 1987, to May, 1988, workshop staff visited classrooms of the participants to help them apply workshop ideas to their specific teaching situations. A second group of teachers was added for the June, 1988, workshops. Much of the time in the June, 1988, workshops was devoted to sharing of teaching experiences among both groups of teachers. Evaluation data from the project indicate that working with teachers over an extended period of time is an excellent inservice format. Participants spoke of the camaraderie they developed over that period and of their opportunities to try out new ideas when workshop staff were available to help with any problems. Participants who attended only the June, 1988, session found teaching suggestions coming from their peers to be realistic and useful. In addition to evaluation data, the report includes outlines of project objectives, instructional activities, project administrative activities, and recommendations for organizers of similar projects. (Author/PK)

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ED299161

Excellence in Mathematics and Science Teaching for the Intermediate Grades: Report of a Long-Term Inservice Project

Peter Kloosterman
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Steven Russo
Jacqueline Gorman

Indiana University

Abstract

From March, 1987 through June, 1988, an inservice program took place to help teachers in grades 3 through 6 improve their skills in teaching mathematics and science. The teachers, from central and southern Indiana, meet for a week in June of 1987 and for three days in June of 1988. From October, 1987 to May, 1988, workshop staff visited classrooms of the participants to help them apply workshop ideas to their specific teaching situations. A second group of teachers was added for the June 1988 workshops. Much of the time in the June 1988 workshops was devoted to sharing of teaching experiences among both groups of teachers.

Evaluation data from the project indicate that working with teachers over an extended period of time is an excellent inservice format. Participants spoke of the camaraderie they developed over that period and of their opportunities to try out new ideas when workshop staff were available to help with any problems. Participants who attended only the June, 1988 session found teaching suggestions coming from their peers to be realistic and useful. In addition to evaluation data, the report includes outlines of project objectives, instructional activities, project administrative activities, and recommendations for organizers of similar projects.

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State of Indiana - Commission for Higher Education
FY 1985-86, Title II-A Program

FINAL PROJECT REPORT

September 22, 1988

Project Titles: **Excellence in Mathematics and Science Teaching for the Intermediate Grades: Crane Area**

Excellence in Mathematics and Science Teaching for the Intermediate Grades: Indianapolis Area

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Project Director:

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Indiana University

Project Evaluator:

Jill Shedd, Ph.D.
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Sponsoring Institution:

School of Education
Indiana University
Bloomington and Indianapolis

Note: Indiana University received two separate grants from the Indiana Commission for Higher Education to conduct workshops for teachers in the intermediate grades. While the geographic locations from which the participants were selected was different for the projects, almost everything else was the same. Participants from both workshops met together in Bloomington in June of 1987 and in Indianapolis in June of 1988. Because the two projects were so similar, this final report is intended as a final report for both projects. In the few instances where activities were different for the two groups, such differences will be clearly spelled out. Thus, unless specified, readers of this report should assume all statements in this report apply equally to the two projects.

Cooperating Institutions of Higher Education: None

Cooperating Public Schools/ School Corporations: None (see response #8 in narrative section of report)

Cooperating Private Schools: None (see response #8 in narrative section of report)

Other Cooperating Bodies: Crane Naval Weapons Support Center
Naval Avionics
(see response #8 in narrative section of report)

Type of Grant Award: Competitive Program

Project Focus: Mathematics and Science

Individuals Served by Project: Public and Private School Teachers

Grade	Number of Public	Number of Private
3	9	1
4	10	0
5	11	1
6	8	2
other	2	2

Project Location and Duration:

Bloomington 6/15/87 - 6/19/87
Indianapolis 6/20/88 - 6/22/88
Visits to Schools 10/1/87 - 5/15/88
(see responses #4 and #7 in narrative section of report)

Project Beginning Date: 3/1/87
Project Ending Date: 6/30/88

Counties Served: Daviess, Dearborn, Decatur, Dubois
Franklin, Greene, Hamilton, Henry, Howard, Jennings
Lawrence, Marion, Martin, Monroe, Ohio, Rush

Major Project Activities:

Workshops in Bloomington in June 1987
Field Trip in June 1987
Workshops in Indianapolis and Bedford in June 1987
Visits to participant's classrooms in 87-88 school year
Workshops in Indianapolis in June 1988
(see responses to #4 and #7 in narrative section of report)

Media and publicity used: None

Historic background of project: New project, never before present

Continuation of project beyond funding period:	No formal continuation, participants will continue to implement project goals (see Appendix B)
Project Matching Funds:	Grant Award-Crane Area: $24,960 Matching Funds (IU): $18,830 Total Allocated Funds: $43,790 Grant Award-Indianapolis Area: $24,960 Matching Funds (IU): $18,830 Total Allocated Funds: $43,790 Note: Actual expenditures were less than allocated totals. The actual expenditure total is not yet available.
Participant Demographics:	Public School Teachers: 6 male 34 female Private School Teachers: 0 male 6 female
Type of Institution:	State University

PROJECT NARRATIVE REPORT

The project narrative report follows the format suggested by the Indiana Commission for Higher Education. Each of the questions posed by the Commission will be stated before the response to that question.

1. Please describe the specific objectives of the project. What was the project intended to do and what results did you hope to achieve?

Project objectives were based on the needs of elementary teachers in general, and on the specific needs of the local school districts that were served. In addition, objectives reflected draft reports of proficiencies in mathematics and science for the upper elementary grades. These proficiencies were compiled by the Center for School Improvement and Performance of the Indiana Department of Education based on goals and needs for mathematics and science instruction in Indiana.

General Objectives:

Public and non-public school teachers who participated in the program should be able to:

1. Provide inservice workshops on mathematics and science teaching for other teachers in the school or school district.
2. Provide consultation in mathematics and science teaching for other teachers in the school or school district.

3. Better individualize mathematics and science instruction to meet the needs of the gifted and talented.

4. Provide instruction designed to increase achievement and to encourage participation in mathematics and science by students from underrepresented and underserved populations.

5. Act as a reference source for obtaining outside consultation and materials related to mathematics and science instruction for other teachers in the school or school district.

Mathematics Objectives:

Public and nonpublic school teachers who participated in the program should be able to:

1. Explain basic mathematical concepts using appropriate concrete and pictorial models. Examples of concepts would be addition as the joining of two sets or fractions as the subdivision of an object or group of objects.

2. Explain place value and computational procedures using appropriate concrete and pictorial models.

3. Teach strategies for solving verbal problems including simple and complex translation problems and process problems.

4. Teach strategies for estimation and mental computation.

5. Use computer software to teach mathematical problem solving as well as to provide drill and practice on computational skills.

6. Teach analysis and simple graphing of numeric data.

7. Recognize situations where a calculator is appropriate in elementary school mathematics and use it in those situations.

Science:

Public and nonpublic school teachers who participated in the program should be able to:

1. Emphasize the phenomenological approach in the teaching of science and assist teachers in developing strategies for working with physical phenomena that illustrate or use concepts they want students to learn.

2. Illustrate basic science concepts using appropriate concrete learning experiences (e.g., simple demonstrations and hands-on activities for students).

3. Provide learning experiences that will motivate students to develop proficiency in the basic and integrated science process skills.

4. Provide exposure to available computer software and experiences in the use of computer software to develop and expand science concepts.

5. Use computer software to analyze and manage data in the context of scientific investigations.

6. Allow interaction between teachers and encourage sharing of effective teaching strategies.

7. Establish a connection to the considerable expertise available at Indiana University in connection with chemical safety and hazards.

2. Please describe the general characteristics of the individuals who participated in your project; and the processes and procedures used to select them.

3. Did the project actually attract the number and type of participants anticipated? Was the selection procedure used appropriate? Please explain. Was there a difference in the level of participation and responsiveness of public school versus private school personnel? Please explain.

NOTE: Given the interrelation of questions 2 and 3 for this particular project, the responses to these two questions have been combined.

The original plan for the project was to involve 60 teachers and help them to become science and mathematics "experts" for their schools. Participants were to meet for five days in June, 1987, interact with project staff during the 1987-88 school year, and meet for two additional days during June 1988. The project was intended for elementary school teachers in grades 3 through 6 who had special interest or expertise in the teaching of science or mathematics.

The project did attract the <u>type</u> of participants anticipated. A number of the participants were science or mathematics specialists in their schools. The remainder taught all subjects, and appeared to be at least average and usually above average in their science and mathematics backgrounds. The grade level distribution of the 1987 participants was as follows:

Number of Participants	Grade Level
2	3
2	4
5	5
7	6
4	other

The project did not attract the <u>number</u> of participants expected. The original proposals called for 30 participants

from the Crane area and 30 participants from the Indianapolis area. Participants were to be selected based on recommendations of superintendents of school corporations in the areas to be served. Four places in each group were reserved for private school teachers from the specified areas.

Participant selection was based on superintendent recommendation for two reasons. First, it was felt that superintendents, in cooperation with their elementary school principals, would be the best individuals to select teachers who could benefit most from the project. Second, state-funded computer and PRIME TIME workshops offered by Indiana University in the summers of 1984 and 1986 had far more applicants than could be accommodated. Requesting superintendent nominations was thought to be an appropriate means of limiting participation to those teachers who would benefit most.

Unfortunately, the selection mechanism proved to be far too restrictive. Despite phone calls and mailings to all superintendents in the areas to be served, only 30 teachers were nominated for the two areas. Of these, 12 from the Crane area and 8 from the Indianapolis area actually attended the first sessions (June, 1987). In response to our inquiries, administrators and teachers noted that the teachers with the best backgrounds in science and mathematics were usually the ones teaching summer school and

thus were unable to attend. A number of teachers said they had small children at home and could not leave for the three-day intensive session during June, 1987. The superintendent of the Indianapolis Public Schools wrote us a letter saying that there were no teachers in the Indianapolis system who were interested in participating!

Level of participation of private school personnel was proportionately higher than expected. Of the eight Indianapolis area participants, 4 were from private schools. Of the 12 Crane area participants, 2 were from private schools.

Given the small number of participants in the first (June, 1987) sessions, several changes were made for the June 1988 sessions. First, the June 1988 session was increased from the proposed two days to three days utilizing funds saved from the low attendance at the first sessions. Second, due to the ineffectiveness of initial contacts with superintendents, personal contacts with teachers were used whenever possible to attract participants for the June, 1988 sessions. Finally, rather than asking for teachers with special expertise in science or mathematics, the sessions were opened to any teacher who felt he or she would benefit by the workshops. Applications for the June, 1988 sessions indicated that most of the applicants were science or mathematics specialists even though this was not a requirement for participation.

The personal recruitment for the 1988 summer session included contacts through school study councils administered by Indiana University faculty. Letters were sent to all elementary school principals in the Southeast Indiana study council, and to a number of school administrators who had worked with Indiana University in the past. In many of these contacts, mention was made of the reputation of the workshop instructors for providing valuable inservice training. Also, participants from the June 1987 workshop were encouraged to find colleagues from their school districts to join them for the June 1988 sessions.

These contacts proved to be relatively successful as 35 applications were received. The goal for the June 1988 workshops was to attract 40 new participants to add to the 20 expected to return from June 1987. Of the 35 who applied, nine failed to attend resulting in 26 participants being added for the June 1988 workshops. All of these individuals were public school teachers. Eight taught grade 3, 8 taught grade 4, 7 taught grade 5, and 3 taught grade 6. Fourteen of the 20 who had been in attendance during June 1987 returned for the June 1988 sessions. All 6 of the June 1987 participants who did not return for the June 1988 workshop said personal reasons rather than the quality of the project resulted in their failure to return.

If workshops of this type were to be repeated, we believe that personal contacts and/or mail contacts with

elementary school teachers and principals would be the most effective way to fill openings, particularly if teachers with expertise in science and mathematics were wanted. Informal contacts with a number of teachers in the districts served by the project indicated they had never heard about the project in the spring of 1987 when superintendents were initially contacted.

In retrospect, one reason the PRIME TIME workshops of 1986 were filled so easily was probably that there was a state-wide newsletter to all PRIME TIME teachers which contained information about the workshops. While none of the personnel of the current project were involved in PRIME TIME workshops in 1987, these were not filled to capacity. It appears that most PRIME TIME teachers who wanted to attend summer inservices did so in 1986 while the rest, who were encouraged to attend in 1987, had no desire to do so.

Related to attracting participants is the issue of paying teachers to attend. For the current project a stipend of $32 per day was paid. It is obvious the paying such a stipend was not sufficient to attract participants to the project.

In short, there are a number of reasons why the current project was not filled to capacity. While we do not know how to assure that future workshops would be filled, it appears that personal contacts with the population to be

served has the greatest potential for attracting the type and numbers of participants desired.

4. Please describe the instruction/service(s) that were delivered to project participants; and list each project activity, its location, the date/time(s) that it occurred, the activity focus or session topic, session leader(s), and the number of participants at each session/activity.

The project began with a one week session during the summer of 1987. Subsequent meetings occurred during the 1987/88 academic year and the summer of 1987. The project staff included Peter Kloosterman, Steven Russo, Charles Barman, Natalie Barman, and Jackie Gorman.

Twenty elementary school teachers participated in the 1987 summer session which took place on June 22-26. The participants from Crane area and Indianapolis met as one group at IU-Bloomington. During this session, the participants were exposed to activities in science and mathematics that required the use of manipulatives to solve various problems. As they worked through these activities, they were provided with examples of how these activities could apply to their current math and science programs. In addition, field trips were organized to introduce the participants to local individuals with expertise in science and mathematics who would be good classroom resource people. The Crane participants took a field trip to the Crane facility near Bedford, Indiana, while the Indianapolis participants visited the Naval Avionics Center in

Indianapolis. The field trips also provided the participants with first hand experience of how the military applies mathematics and science concepts to its research and development efforts.

During the 1987/88 academic year, Jackie Gorman visited each of the first session participants in their respective schools about three times. The purpose of her visits was to assist them in developing science and math lessons and identifying specific resources they could use for their classrooms. In addition to these visits, the entire project staff met with the Crane and Indianapolis participants in February, 1987 where plans were made for the 1987 summer session.

Forty elementary school teachers attended the second summer meeting at IUPUI on June 20-22, 1987; 14 from the 1987 session and 26 new participants. Note that the 1988 session was one day longer than originally proposed. The participants were provided with a wide variety of ideas of how to integrate critical thinking into their science and mathematics curricula. In addition, they participated in small group discussions to share their own ideas about teaching science and mathematics. The following table shows the day by day activities of the workshops.

Table of Major Instructional Activities

Activity	Date	Focus
87 Workshop-Day 1	6/15/87	Science process skills Introduction to Problem Solving Chemistry "Magic Show"
87 Workshop-Day 2	6/16/87	Chemistry activities for elementary school Math problem solving Math manipulation Software evaluation
87 Workshop-Day 3	6/17/87	Critical thinking in math Critical thinking in science Classroom organization and management
87 Workshop-Day 4 (Crane area)	6/18/87	Meet in Bedford to discuss math problem solving
87 Workshop-Day 4 (Indianapolis area)	6/18/87	Tour of Naval Avionics in Indianapolis Discussion of applications of science and math in Industry
87 Workshop-Day 5 (Crane area)	6/19/87	Tour of Crane Naval Weapons Support Center Discussion of applications of science and math in Industry
87 Workshop-Day 5 (Indianapolis area)	6/19/87	Meet at IUPUI to discuss math problem solving
Classroom Visitations (about 3/ teacher)	10/87 to 5/88	Jacqueline Gorman visits teachers to aid in lesson planning and implementation of workshop ideas

Crane Area Meeting (Crane area only)	2/17/88	All Crane area participants and all instructional staff meet in Bedford to discuss progress in meeting workshop goals.
Indianapolis Area Meeting (Indianapolis area only)	2/24/88	All Indianapolis area participants and all instructional staff meet in Indianapolis to discuss progress in meeting workshop goals.
88 Workshop-Day 1	6/20/88	New participants introduced to math problem solving and science process skills. Returning participants discuss science teaching, evaluation of student learning, and plan presentations.
88 Workshop-Day 2	6/21/88	Sharing of activities between new and returning participants Discussion of Science Fairs
88 Workshop-Day 3	6/22/88	Discussion of classroom management Planning for sharing new knowledge with other teachers Evaluation of project Superconductivity demonstration

5. Please describe participant reactions to your project sessions and activities, noting any significant differences among types of participants and other findings that you deem important.

Participant reactions to the overall project were collected as part of the project evaluation. A more detailed summary of participants' thoughts is presented in response to question #10. The overall assessment of the project is presented below.

Summer 1987 Workshop and 1987-88 Classroom Visitations

The overall reaction to the summer 1987 program and the classroom visitations in 1987-88 was very positive. The participants described the project as a valuable experience. Their involvement served to renew their interest in teaching mathematics and science and to provide new and valuable information and activities for teaching better in these two areas. As noted elsewhere in this report, the majority of survey respondents (11 of 16, 69%) stated that the project had a very positive impact on their teaching in mathematics and science.

At the same time, weaknesses in these facets of the overall project were noted. Most often mentioned were the classroom visitations during the academic year. The participants would have liked more visits, as well as visits by both mathematics AND science project staff. Other weaknesses cited by the participants might be referred to as administrative or organizational shortcomings. Individual suggestions were that the project needed more definite objectives, a focus on fewer concepts in more depth, and identification of one administrative coordinator.

Summer 1988 Workshop

Both the new and returning participants described the workshop at IUPUI as valuable and beneficial. The teachers viewed the program as a great motivator to teach mathematics

and science and to use the new ideas and activities presented. Noted most often as a positive feature of the program were the opportunities provided to interact with other teachers and share ideas. The new participants wrote favorably about the information shared by the returning teachers. An additional asset to the program that the teachers indicated was the opportunity to do a variety of science activities and actually witness how they work and how other teachers use them.

Weaknesses in this facet of the project again were cited as administrative or organizational shortcomings. Individuals stated that the lodging and classroom arrangements were too dispersed. Comments were also written suggesting a more focused/in-depth program and a program more closely suited to the teachers' backgrounds and level of knowledge.

Conclusion

The overriding reason that teachers gave for attending the program was to learn new ideas and new ways to teach mathematics and science. Individual participants added that they were hoping to gain new materials for enrichment sessions and more able students. The results of the evaluation surveys indicate that these expectations of the participants were met. The comments from those teachers interviewed elaborated on the positive features of this

project. Noted most often was the opportunity that the project provided to work with other teachers and to develop a camaraderie in discussing concerns and sharing ideas. Two participants pointed out that this experience relieved their sense of isolation in their own school. Another positive feature was the demonstration of new ideas. Those interviewed emphasized the value of seeing the materials in use. The project also provided teachers with valuable information about ordering equipment as well as about resource contacts.

To conclude, those interviewed provided a general reflection on the value of this particular project. Participants liked the program format of the multi-day. They liked the camaraderie, the fellowship and the sharing with other teachers that the project offered. As to its content, the participants liked the emphasis on process skills and noted the importance of the process foundation. As one teacher noted "we know what to teach but the how is left out." The participants felt the program focused on the "how."

6. Please describe the materials produced for and by the project; the participants' responses to using the materials; your assessment of their usefulness to participants and their availability for dissemination. Attach examples as may be appropriate.

Prior to the start of the summer 1987 session, a 140 page packet of materials was put together in a looseleaf

notebook for each participant. Some additional materials were mailed to participants throughout the 1987-88 school year. In addition, most of the participants wrote about activities they had used in class. Those activities were duplicated for all participants. Copies of the looseleaf notebook materials were also given to summer 1988 participants. A copy of the looseleaf materials has been attached to this document as Appendix C.

Looking at the supplementary materials, one will find that many are copies of already existing information. When existing information was not sufficient, materials were written specifically for this project. The samples of mathematical "process" problems, the science process skills handout, and the software evaluation forms are examples of materials that were written for the project.

A majority of the materials distributed were discussed during the summer 1987 session and thus were probably of more value to the initial as opposed to the summer 1988 only participants. However, the materials were predominantly self-explanatory so they should also have been at least somewhat useful to the 1988 only participants. In addition, some of the materials were intended solely as background information to be used as needed by participants. These materials were probably equally useful to all participants.

Participants at the summer 1988 workshops were also allowed to order materials to use in their classrooms.

These were science materials, mathematical manipulatives, and books of supplement/enrichment activities. The materials were intended to provide teachers with materials over and above the minimal amount of such materials provided by schools. While the original plan was to allow each participant to select $25 worth of such materials, the fact that the workshop attracted fewer participants than expected allowed us, with permission from the Indiana Commission for Higher Education, to increase the amount to $100 per person. Orders for materials were taken during the summer 1988 session. The materials were to have been shipped by suppliers in time for the start of school in August, 1988.

As part of the project evaluation, participants were asked to comment on project materials. Comments focused on the opportunity to order supplemental classroom materials. One participant described her reaction to getting materials by saying, "I feel like a kid in a candy store." Participants appreciated the money to order materials, as well as the opportunity to get advice about various items. Comments about the materials received during the project were favorable as to the amount and to the fact that the teachers had used or witnessed activities that used them.

7. Please describe the administrative/management activities of the project; identify the personnel (faculty, student assistants, and other individuals) who were involved in the project; the amount of time they devoted to the project and their project role/responsibility.

This project was administrated through the Office of School Programs at IU-Bloomington. Donald Winslow, from the Office, acted as project director. Paula Thrasher, a staff member of the office, was very helpful in keeping track of budgets, ordering supplies, and other administrative details.

The key instructional personnel for this project were, Charles Barman (associate professor of science education, IUPUI), Jacqueline Gorman (graduate assistant in mathematics education, IU), Peter Kloosterman (assistant professor of mathematics education, IU), and Steven Russo (assistant professor of chemistry, IU). Natalie Barman (teacher at Park Tudor school in Indianapolis) served as a consultant and was a project instructor for the 1988 summer session.

Jill Shedd (evaluation specialist and Assistant Director of Academic Affairs at IUPUI) was the evaluator for the project. Anne Fisher (undergraduate assistant) provided secretarial support. The following outlines the activities for the duration of the project:

Table of Administrative Activities: March 1, 1987 to June 30, 1988

March, 1987

A. Staff notify superintendents that proposed project has been funded so they can begin considering candidates.

B. Superintendents select participants.

C. Staff select exact dates for June, 1987 workshops.

D. Staff make final housing and laboratory arrangements for June, 1987 workshops.

E. Staff begin planning for late April/early May meeting with participants.

F. Staff begin planning of instruction for June, 1987 workshops.

April, 1987

A. Staff continue planning for June, 1987 workshops.

May, 1987

A. Preliminary participant meetings take place.

B. Staff continues planning for June, 1987 workshops taking into account needs uncovered at preliminary meeting.

June, 1987

A. Initial training takes place.

1. 3 day workshop at Indiana University
2. 1 day tour of Crane Naval Weapons Support Center or Naval Avionics
3. 1 day workshop at school in geographic center of area served

July, 1987 through January, 1988

A. Staff visits to classrooms of participants from October through January.

February, 1988

A. Winter meeting (half-day) all participants (by area).

B. Staff visits to classrooms continue.

C. Staff begin planning for June, 1988 workshops.

D. Staff begin recruitment of new participants for summer 1988 workshop.

March, 1988

A. Staff visits to classrooms continue.

B. Staff continue planning for June, 1988 workshops.

C. Staff continue recruiting new participants.

April through May, 1988

A. Staff visits to classrooms continue.

B. Staff continue planning for workshops.

C. Evaluator begins collecting data from participants.

June, 1988

A. Training takes place for three days at IUPUI.

B. Evaluator collects data on participant reactions to program.

C. Principal investigators begin final narrative report.

July through August, 1988

A. Evaluator summarizes evaluation data.

B. Principal investigators complete final narrative report.

C. Project director completes budget narrative.

D. University budget office completes formal budget report.

8. Please identify any cooperative efforts or assistance provided by public or private school staff or administrators, community organizations, groups, state and local government, the sponsoring institution, and others.

The majority of the project efforts were undertaken by and through Indiana University School of Education in Bloomington and Indianapolis. The Indiana University Office of School Programs donated secretarial and administrative help to the project. Donald Winslow of the Office staff donated five percent of his time to serve as project director.

Cooperative efforts were provided by several other agencies. North Lawrence Community Schools, St. Vincent School in Bedford, and Orchard Day School in Indianapolis provided meeting rooms during the summer of 1987 and during the 1987-1988 school year. Participants in the June 1987 workshop were released by their school district from class for a day for a meeting in February, 1988. Crane Naval Weapons Support Center and Naval Avionics provided one-day tours free of charge.

It is also important to note the cooperative efforts provided by the project participants. While these individuals were paid a minimal amount for days they attended the summer workshops, they put in considerable after-school planning time to implement some of the workshop activities. They traveled to the workshops at their own expense and have agreed to share workshop ideas with other

individuals in their schools. The workshop participants are committed teachers who have donated much of their own time and energy to improve their teaching ability.

9. Please indicate the impact that you feel your project has had on project participants. Is there any evidence that participants are using project concepts, techniques, materials, activities or information in their classrooms? Is there any evidence that there is an impact on teacher performance in the classroom or on students? Provide illustrations, examples or evidence as may be necessary.

Impact of Project on Participants

The teachers were asked on the written surveys (see Appendix A) to describe the impact of their project participation on both their teaching and their role in the school. Please note that only the returning participants could address whether the project influenced their teaching based upon their participation in the Bloomington workshops during the summer, 1987.

Impact on Teaching

The majority of returning teachers who completed the evaluation (11 of 16, 69%) indicated that they had changed their approach to teaching mathematics and/or science as a result of their participation in the project. Observation notes from classroom visitations by project staff confirmed that these changes had taken place. The types of changes noted include:

- use of more science activities;

- more time directed to problem solving;
- use of more exploratory and manipulative techniques and less use of the test;
- use of improved questioning techniques, such as waiting longer for students to respond;
- use of more hands-on activities in mathematics;
- consideration of process skills in teaching strategies

It should be noted that among those teachers who indicated no change in their teaching several wrote that they were already using the types of hands-on activities presented in the project. The participants wrote also that students loved the activities, responded better to the hands-on opportunities, and exhibited more enthusiasm and interest in the subjects with the teaching changes instituted.

Those interviewed elaborated on how the project would impact their teaching. They stated that they would in some way incorporate the ideas from the program into their teaching by using more problem solving in mathematics, and by providing students more hands-on opportunities in science. Several noted specifically that this experience has motivated them to go beyond their texts in their teaching. Two individuals interviewed pointed out the importance to them in learning more about students' process

skills and thinking skills as a foundation to their teaching and expectations of their students.

Impact on Role in the School

Both returning and new project participants who completed evaluations stated that the project would impact their role in the school. Reasons cited most often as to why their role would change included the increased confidence in their abilities that project participation provided, as well as the amount of new information acquired. The types of changes that the teachers anticipated were:

- sharing ideas with other teachers and principals.
- increasing interaction with other teachers in school, and
- working with other teachers to review curriculum

Participants also wrote that they would carry back to their schools the excitement the project instilled and would encourage the use of hands-on materials, while promoting textbooks as supplemental resources.

10. Discuss the nature and findings of the project evaluation. Describe the evaluation procedure used, who administered it and the findings of the evaluation. Please comment on the degree to which you feel your project achieved the results that you intended in your project proposal.

Evaluation Procedure

Dr. Jill D. Shedd was hired to conduct an evaluation of the project. Dr. Shedd is currently the Assistant Director

of Academic Affairs at Indiana University School of Education at IUPUI. Her educational background is in evaluation, and she has served as an evaluation consultant on other funded projects.

The evaluation of this project included use of various written evaluations completed by the participants, as well as interviews with a random selection of participants. Four written surveys were used; participant evaluations of the Bloomington summer 1987 program, separate evaluations of the IUPUI summer 1988 program by the new and returning participants, and an overall participant evaluation of the instructors. Evaluations were mailed to the 1987 participants at the end of the 1987-88 school year. Sixteen were completed and returned representing a 64% response rate. At the end of the IUPUI summer 1988 program separate evaluations were distributed to the new and returning participants. The response rates from each group was 100%. Copies of each of the evaluations distributed are attached in Appendix A.

During the session at IUPUI, ten participants were randomly selected and interviewed. Interviews were conducted to gain more personal reflections about the project that could not be captured adequately from paper and pencil surveys. Of the ten interviewed, four were returning teachers and six were participating in the project for the first time. In each interview the teachers were asked to

describe their reasons for participating in the project, their overall impressions of the programs, the impact their participation will have on their teaching, and the materials received.

Evaluation Results

A specific assessment of the different project components drawn from the participants' written evaluations follows.

Summer 1987 Workshops (Bloomington)

Overall, the individuals rated each of the workshop sessions highly. On a five point scale, with five being the highest mark, the range of marks for the individuals was 4.7 - 3.9. The tours through the Crane Naval Weapons Support Center and Naval Avionics Facility received good but less enthusiastic marks of 3.5 and 3.4, respectively.

1987-1988 School Year Activities

Of the activities during the 1987-1988 academic year, the participants rated most favorably the classroom visitations by the project staff. On average each participant's classroom was visited three times during the course of the year at which time the project staff demonstrated the use of mathematics activities and materials with the students.

Project Objectives

With respect to the summer 1987 workshops and classroom visitations, the participants indicated that the objectives outlined by the project directors were met for the most part. The individuals inferred the program's success by rating how effectively they could do the things the project directors set out to achieve in this project. The participants rated most favorably (4.4 - 4.0 on a five point scale) their abilities listed below as a result of their program participation:

- to illustrate basic science concepts using appropriate concrete learning experiences,
- to provide learning experiences that will motivate students to develop proficiency in the basic and integrated science process skills,
- to explain basic mathematical concepts using appropriate concrete and pictorial models, and
- to recognize situations where a calculator is appropriate in elementary school mathematics and use in those situations.

The least favorable assessments, although the marks were 3.4 - 3.2 on the five point scale, were directed toward the project objectives associated with the use of computer software and individualized instruction for the gifted and talented.

The participants were asked to identify the project objectives which were most important to them. The four listed most frequently were:

- to explain basic mathematical concepts using appropriate concrete and pictorial models,
- to learn strategies for solving verbal problems including simple and complex translation problems and process problems.
- to illustrate basic science concepts using appropriate concrete learning experiences, and
- to gain learning experience that will motivate students to develop proficiency in the basic and integrated science process skills.

It is a positive reflection on the project to note that the teachers rated most favorably their abilities in three of these objectives as a result of their participation.

Summer 1988 Workshops (IUPUI)

Both new and repeating participants rated most highly the opportunity to share teaching activities among themselves and to discuss the implementation of new ideas and activities in the classroom. Less favorable evaluations were given to the workshops on questioning, science fairs, and being a school's science and mathematics leader. Overall, the returning participants rated these three sessions less favorably than the new participants.

Project Objectives

The returning and new participants were given different sets of questions about the project objectives. Both groups were asked to address the project objectives associated with the participants' roles as resource persons in their school and/or school district. Both groups noted more favorably their ability to effectively interact with teachers and encourage them to share effective teaching strategies as a result of their project participation. Also, both groups indicated that as a result of their participation they can effectively serve as consultants about mathematics and science teaching and resource persons in the schools and school districts. Yet, both groups (returning and new participants) were not as positive about their ability to conduct workshops for other teachers about mathematics and science teaching.

The new participants were given an additional set of project objectives to assess having to do with the project's impact on their teaching strategies. On a 1 to 5 scale, participants teaching strategies which were most affected were:

- allow interaction between teachers and encourage sharing of effective teaching strategies (4.5),
- teach strategies for solving verbal problems including simple and complex translation problems and process problems (4.3),

- provide learning experiences that will motivate students to develop proficiency in the basic and integrated science process skills (4.3), and
- illustrate basic science concepts using appropriate concrete learning experiences (4.2).

These results are comparable to the assessment given by the returning participants on their survey of the earlier components of the project.

The new participants also rated positively the project in terms of meeting their personal expectations. Overall, the teachers came to learn effective techniques and new ideas for teaching mathematics and science, and they indicated that the program provided this opportunity. The only disappointments as to meeting individual expectations of the project were associated with expectations for specific information about mathematical manipulatives, teaching mathematical concepts, and teaching to a range of students' abilities. These mathematical topics were the focus of the Summer 1987 program.

Instructors

The overall quality of the instruction was given very high marks. The instructors were rated most highly for being knowledgeable about the topics covered and for their enthusiasm about teaching.

11. If you were asked to conduct your project again next year with a new set of participants, what changes/modifications would you make in the project that would enhance its effectiveness?

The above question was posed, as part of the project evaluation, to all project participants. The responses of the participants have been integrated with suggestions from project staff to answer this query.

The first suggestion for change would be to promote the project in a different way in order to represent more clearly and specifically the focus of the project and to reach more teachers. Our problems with attracting participants were outlined in the response to questions 2 and 3, yet the response to question 10 indicated the project was beneficial to those involved. Unfortunately, it appears that many teachers do not wish to be involved in projects of this type, predominantly because of the time commitment. Thus, in future projects, we recommend that organizers of a project be less selective in who they admit, working to attract those teachers who are interested. This appears to be done most effectively in a majority of school districts by working directly through elementary school teachers and principals rather than superintendents.

Several of the participants suggested that the workshops cover fewer topics so that those covered would receive more in-depth treatment. This suggestion is probably well taken. The staff felt that if they could just

get participants to believe that process skills and critical thinking were the important features of elementary school science and mathematics, they would have achieved a lot. It appears this goal was met although a greater variety of activities related to this goal were presented than were necessary.

An additional point concerning reducing the number of topics should be noted. Several summer 1988 participants complained that using mathematical manipulatives was not taught. Although, this topic was originally planned, it was abandoned as it was felt there was not enough time to adequately cover it. Such curricular choices are always going to alienate a few people. It is the feeling of the project staff that it is still better to limit the number of topics and to cover selected topics well than it is to cover too many topics with insufficient depth.

One goal of the workshops was to provide teachers with the skills to train other teachers in their schools. Even with two summers to work with teachers, this goal was too ambitious. Most teachers are not used to being "instructional leaders" and are anxious about "preaching" to their colleagues. They are willing to act as a resource when asked. The workshops adequately trained them for that role.

One aspect of the project that both participants and staff felt was a strength and should NOT be changed was the

two-summer format. To begin with, two-summer participants gained a certain camaraderie with their peers over this extended period of time. When they returned for the June 1988 workshop, they knew each other and had plenty of experiences related to teaching science and math to relate. Project staff were happy with this format as it enabled them to work with teachers during the second summer to "fine tune" the teaching suggestions made during the first summer. Several teachers did not return for the second summer due to personal reasons. This is not surprising as it is almost impossible to get individuals to make commitments a year in advance.

Another strong aspect of the project was having project staff visit participant's classrooms. Participants felt this was very important and useful. Unfortunately, such visits are very time consuming for project staff. Almost all visits were made by Jacqueline Gorman, a mathematics education graduate student. She did an excellent job of aiding teachers in mathematics but was limited in her ability to make suggestions concerning science. It was the intention of project staff to hire a graduate student in science education to also make visits. Unfortunately, no well-qualified individual was found and it was decided it would be better to send no science person than it would to send someone who would be of no value to the teachers. University limits on the amount a graduate student can be

paid may be partly responsible for difficulties in hiring experienced teachers as graduate students. Although it would be expensive, hiring an experienced teacher on a full time staff salary may be one way to insure that classroom visits could be made by a qualified individual. On a final note, we suggest trying to limit the geographic area served by any individual assigned to visit classrooms. Ms. Gorman, because of the broad area she had to cover, often spent more of her time commuting to schools than she did working with teachers once she got to the schools.

A final comment that should be made concerning changes in any project is the problem of administering workshops where a number of people are involved. There is probably no easy way to improve the situation but future workshop organizers should be aware that organizing is often more difficult than teaching once a workshop is set up. For example, knowing who to contact to attract participants is difficult. If too many people apply, then those that are not selected often are unhappy. Ten people who signed up for the summer 1987 workshop failed to show up leaving us with even more unfilled spaces than we anticipated. Finding lodging was another major problem for us. The place where we originally planned to house participants for the Indianapolis workshop stopped taking people on a night-by-night basis soon after we submitted the original proposal. Arrangements were made in March, 1988 to house 48

people at the IUPUI union for the June 1988 workshop. Three weeks before the June 1988 workshop was to begin, we contacted the union to confirm the reservation and found that our reservation had been "reduced" to 18 by union staff because another group had "higher priority". We were able to arrange suitable housing at the last minute but it was very tense until those alternative arrangements were confirmed. It is situations such as these, rather than curricular issues, which make administering projects of this type exceptionally difficult.

12. The purpose of the Title II-A program is to improve the quality of classroom teaching of math and science and to better understand the problems, concerns, and realities that elementary, middle, and high school teachers face in teaching (math and) science. What insights have you gained through your project that would increase our understanding of the issues, concerns and realities that teachers face? What recommendations would you make to federal, state and local officials who are looking for ways to improve teacher performance and student performance in math and science.

Drawing from the participants' comments about this project, there are several suggestions to consider in improving teachers' attitudes and performance in teaching mathematics and science.

1. Teachers need opportunities to share and discuss ideas.
2. Teachers need more training in process and higher order teaching-learning strategies.

3. Elementary teachers particularly need a greater knowledge base in science in order to teach it confidently and well. Many seem to avoid teaching science and/or teaching it creatively due to a lack of confidence in their understanding of science.
4. ISTEP, the Indiana statewide testing program, was a major concern for teachers in our project. Process skills and critical thinking in science and mathematics are secondary to low level factual knowledge in this test and thus teachers were concerned before the test that they needed to stress memorization of facts more than critical thinking to help students pass the test. When very few students (statewide) failed the test, concern diminished but it should still be noted by State officials.
5. Teachers are professionals and should be treated as such. The stipend we paid them was small but it helped to make them feel that professional development was something officials in education were interested in. It also helped them to feel that personal improvement is something to take pride in. We made a major mistake during the summer of 1987 as we provided dormatory rooms that were not air conditioned. Several of the participants pointed out that other professionals would not be expected to live in such accommodations.

6. Many school boards and school administrators do not understand the importance of process skills and critical thinking in instruction and thus are not supportive of teachers who work to improve such skills in their students. This is exemplified by the minimal allowance given to most teachers for math and science materials.
7. In general, educational reform is a long, slow process. By making small improvements, the system will eventually improve but it will take time. The Title-IIA program is a step in the right direction and should be continued. Officials must be aware, however, that large-scale reform of instruction in math and science will not take place quickly.

APPENDIX A

Evaluation Instruments

Excellence in Mathematics and Science Teaching
for the Intermediate Grades

1987 - 1988

PARTICIPANT EVALUATION

NAME _____ SCHOOL _____

GENERAL DIRECTIONS

Please respond to each of the questions below based upon your participation in the project, "Excellence in Mathematics and Science Teaching." Unless otherwise indicated, please use the following response scale:

5 - Strongly Agree 4 - Agree 3 - No Opinion 2 - Disagree 1 - Strongly Disagree

Summer 1987 Program

EACH OF THE WORKSHOP SESSIONS LISTED BELOW WAS INFORMATIVE AND USEFUL.

_____ 1. chemistry "magic" show

_____ 2. in-class chemistry experiments

_____ 3. presentations/discussions on mathematical problem solving

_____ 4. presentations/discussions on using mathematical manipulatives

_____ 5. discussions of science process skills

_____ 6. discussions of questioning skills

_____ 7. The tour of the Crane / Naval Avionics Facility was beneficial. (Please circle the name of the tour you attended.)

8. List below the one session you feel was the very best. Why?

Please remember to use the following response scale:

5 - Strongly Agree 4 - Agree 3 - No Opinion 2 - Disagree 1 - Strongly Disagree

School Year 1987-88 Activities

_____ 9. The meeting in February of the project participants was beneficial.

_____ 10. The project staff visitations to my classroom were helpful.

_____ 11. How many visits were made to your classroom by the project staff during the school year?

12. Describe the extent to which you used in your teaching the past year the materials distributed at the end of the summer program.

Project Objectives

HAVING PARTICIPATED IN THE PROJECT, I BELIEVE I CAN EFFECTIVELY

_____ 13. explain basic mathematical concepts using appropriate concrete and pictorial models.

_____ 14. explain place value and computational procedures using appropriate concrete and pictorial models.

_____ 15. teach strategies for solving verbal problems including simple and complex translation problems and process problems.

_____ 16. teach strategies for estimation and mental computation.

_____ 17. use computer software to teach mathematical problem solving as well as to provide drill and practice on computational skills.

_____ 18. teach analysis and simple graphing of numeric data.

_____ 19. recognize situations where a calculator is appropriate in elementary school mathematics and use it in those situations.

_____ 20. illustrate basic science concepts using appropriate concrete learning experiences.

_____ 21. provide learning experiences that will motivate students to develop proficiency in the basic and integrated science process skills.

Please remember to use the following response scale:

5 - Strongly Agree 4 - Agree 3 - No Opinion 2 - Disagree 1 - Strongly Disagree

Project Objectives (cont.)

_____ 22. provide exposure to available computer software and experiences in the use of computer software to develop and expand science concepts.

_____ 23. establish a connection to the considerable expertise available at Indiana University in connection with chemical safety and hazards.

_____ 24. better individualize mathematics and science instruction to meet the needs of the gifted and talented.

_____ 25. provide instruction designed to increase achievement and to encourage participation in mathematics and science by students from underrepresented and underserved populations.

Personal Objectives

_____ 26. From the project objectives listed above, please identify the THREE that were most important to you, using the corresponding numbers
_____ 27. (numbers 13 - 25).

_____ 28.

29. Please describe below any additional expectations you had for participating in this project that were NOT MET.

Project Impact on Your Teaching

_____ 30. Have you changed your approach to teaching mathematics and/or science as a result of your participation in this project? (Yes or No)

31. If Yes, describe how you have presented the subject(s) differently.

32. If Yes, how did your students respond to your changes?

Overall Evaluation

33. In summary, how would you describe this project and its value?

34. Were the project repeated, identify the activities you would recommend be included.

35. What would you recommend be changed? Why?

Summer 1988

PARTICIPANT EVALUATION

NAME _____ SCHOOL _____

GENERAL DIRECTIONS

Please respond to each of the questions below using the following response scale:

5 - Strongly Agree 4 - Agree 3 - No Opinion 2 - Disagree 1 - Strongly Disagree

Summer 1988 Program

EACH OF THE WORKSHOP SESSIONS LISTED BELOW WAS INFORMATIVE AND USEFUL.

_____ 1. sharing of activities between returning and new participants

_____ 2. discussion groups on implementing new ideas in my classroom

_____ 3. discussion/videotape on questioning

_____ 4. science fair activities session

_____ 5. discussion of being a "leader" for science and mathematics in my school

6. List below the one session you feel was the very best. Why?

Program Objectives

HAVING PARTICIPATED IN THIS PROGRAM, I BELIEVE I CAN EFFECTIVELY

_____ 7. provide inservice workshops on mathematics and science teaching for other teachers in my school or school district.

_____ 8. provide consultation in mathematics and science teaching for other teachers in my school or school district.

_____ 9. act as a resource to obtain outside consultation and materials related to mathematics and science instruction for other teachers in my school or school district.

_____ 10. allow interaction between teachers and encourage sharing of effective teaching strategies.

HAVING PARTICIPATED IN THE PROJECT, I BELIEVE I CAN EFFECTIVELY

_____ 11. teach strategies for solving verbal problems including simple and complex translation problems and process problems.

_____ 12. illustrate basic science concepts using appropriate concrete learning experiences.

_____ 13. provide learning experiences that will motivate students to develop proficiency in the basic and integrated science process skills.

_____ 14. better individualize mathematics and sicnece instruction to meet the needs of the gifted and talented.

_____ 15. provide instruction designed to increase achievement and to encourage participation in mathematics and science by students from underrepresented and underserved populations.

Personal Objectives

16. Please describe your own objectives for participating in this project and identify whether these expectations were met or not.

Project Impact on Your Role in the School

_____ 17. Do you see your role/interaction with other teachers changing as a result of your participation in this project? (Yes or No)

18. Please elaborate on your answer, i.e., reasons for no change, reasons for change, types of change.

19. What kinds of activities, materials, training, etc. do you feel are needed to improve the teaching of mathematics and science in your school and school district?

20. What role in the above do you see for yourself as a result of your participation in this project?

Overall Evaluation

21. In summary, how would you describe this program at IUPUI and its value?

22. Were the program repeated for teachers, identify the activities you would recommend be included.

23. What would you recommend be changed? Why?

Mathematics/Science Summer Institute, June 1988
Instructor Evaluation

Check the appropriate space.

____ Returning participant

____ New participant

Directions: Please circle the numeral (1 to 5) which best describes how you feel about instruction throughout the institute.

1. The overall quality of instruction in this institute was

   high 5 4 3 2 1 low

2. The instructors were knowledgeable on topics covered.

   agree 5 4 3 2 1 disagree

3. The instructors were enthusiastic about teaching the institute.

   agree 5 4 3 2 1 disagree

4. The instructors provided enough time for questions.

   agree 5 4 3 2 1 disagree

5. The instructors were well prepared for institute sessions.

   agree 5 4 3 2 1 disagree

6. The instructors explained ideas clearly.

   agree 5 4 3 2 1 disagree

Additional comments about the overall quality of instruction or about individual instructors:

APPENDIX B

Participant Agreement to Implement Project Objectives

Personal Implementation Goals

Name _____

School _____

Please describe the nature of at least two science/mathematics activities that you agree to use with your classes next fall. These could be one day activities or long range projects (e.g. weekly problem-solving sessions). Explain how these activities will be incorporated into your current science/mathematics program.

APPENDIX C

Supplemental Readings (Partial Collection)